The Center for Independent Experts (CIE) Panel Review of the Joint Pacific Sardine and Pacific hake (SaKe) acoustic-trawl survey

Independent Peer Review Report

By

Jon Helge Vølstad[1]
Strangehagen 22
5011 Bergen, Norway

February 2014

[1] Representing Center of Independent Experts

Executive Summary

I believe that a Joint Pacific Sardine and Pacific Hake survey (SaKe) during summer will be an improvement over continued independent bi-annual surveys for sardine and hake. A joint SaKe would not only continue to support stock assessments of sardine and hake, but also would improve the basis for broad scale ecosystem monitoring and modeling that can be used to investigate impacts of environmental and climate change. This would be consistent with national and international efforts to move towards ecosystem-based management of marine fisheries resources. It is recommended that Southwest Fisheries Science Center (SWFSC) and Northwest Fisheries Science Center (NWFSC) link their databases in the future so that acoustic, biological, environmental, and oceanographic data can be analyzed efficiently.

One concern is that a joint SaKe survey takes longer time to cover the whole coast, possibly compromising a synoptic coverage several species. This could be alleviated if the planned extra NOAA ship is used to conduct concurrent sampling with 2 ships in the US zone, while Canada conducts the survey in Canadian zone.

Ideally, SaKe surveys would be conducted annually to support the stock assessments of the highly fluctuating sardine and hake stocks. However, the experience from running the 2012 and 2013 SaKe surveys suggests that NWFSC scientific staff were overloaded, and that the annual participation in the fieldwork came at the expense of time needed for research. Several concerns were brought up during the review meeting regarding logistics and staffing, and it was informed that the SaKe survey had reduced collection of oceanographic and environmental data as compared to what had been the standard in the independent hake and sardine surveys. I therefore support the proposed option that SaKe surveys be conducted bi-annually over a period of 5 years, with more flexible use of US ship-time for research in the "off-years". Industry is generally supportive of such a plan, which leaves the flexibility to address special needs in "off-years" if something doesn't look right on the stock assessment side, as for 2012. Canada has not committed to annual surveys, and the bi-annual independent sardine and hake surveys have generally been deemed sufficient to inform the stock assessments in the past. In addition, the hake assessment team will only accept survey years that cover the full range of hake distribution in US and Canadian waters. The advantage of bi-annual SaKe surveys with more flexible use of ship time in alternate years is that this will provide the opportunity for SWFSC and NWFSC to strengthen their collaboration, work out logistical bottlenecks and staffing needs, and conduct research to develop an effective long-term joint ecosystem survey that also supports management needs (stock assessments for hake and sardine). It is recommended that SWFSC and NWFSC conduct at least one workshop during the 5-year period as part of the methods development.

The systematic design for the SaKe acoustic-trawl survey is robust for covering hake and multiple coastal pelagic species with varying patchiness and areas of occupancy, provided that the spatial coverage E-W and N-S is adequate. The 10 nm spacing of transects used in SaKe provides estimates of abundance and biomass of hake with relative standard error (RSE) of around 5%, which is exceptionally precise, while biomass estimates for sardine based on the 2012 and 2013 SaKe surveys had low to moderate precision with RSE of approximately 33% and 28%, respectively. More precise estimate of sardine biomass could be achieved by

allocating more sampling effort to cover sardine habitat, with little loss in the precision in biomass estimates for hake. If the spacing between transects is reduced to, say, 15 nm, in the baseline SaKe survey, little loss in precision in biomass estimates for hake is expected. The effects of sample size (number of transects) on the relative error of biomass estimates can be evaluated through simulations based on historic data. Some increase in spacing of transects along most of the coast (say 15 nm) would allow an increase in sample sizes for CPS which occupies more limited areas. Also, the accuracy of hake and sardine biomass estimates may be improved if the length of transects E-W are extended when needed to improve coverage.
A simulation study has already shown that the random removing of 10 transects had negligible (0.2% reduction) in the relative standard error of the hake biomass estimate, while reduced coverage N-W can cause severe bias.

The use of kriging to estimate the precision in biomass and abundance estimates for hake is strongly dependent on the assumption of isotropic variograms since the acoustic transects in the SaKe survey are systematically spaced 10 nm apart in the N-S direction. For a check, alternative methods for estimating variance based on ratio estimators and post-stratification could be applied. Also, the autocorrelation in acoustic biomass estimates values at 10 and 20 nm along transects could be compared to the correlation between transects 10 nm and 20 nm apart.

It is recommended that the level of biological sub-sampling and data collections at each trawl station for hake be evaluated. In particular, the number of fish sampled for age appears to be too high. This could be evaluated through simulations to see how subsample size at the trawl station affects the precision in estimates of numbers at age through age-length keys for the combined acoustic-trawl survey. The effective sample size for estimating age is likely to be driven by the number of transects and trawl stations sampled, and may be little affected if less fish are aged at each trawl station.

1. Background

In 2012, a newly integrated acoustic-trawl survey of both Pacific Hake and Pacific sardine was implemented in waters off the US and Canada through collaboration and partnership between Southwest Fisheries Science Center (SWFSC) and Northwest Fisheries Science Center (NWFSC) fishery scientists, as well as Canada's Department of Fisheries and Oceans (DFO) and the fishing industry. The survey's primary goal was to measure the distributions and abundances of Pacific hake and Pacific sardine. In addition, oceanographic and environmental data were sampled to estimate the physical oceanographic habitats for each target species. Results of this survey were used in the 2013 assessment of the Pacific hake stock in US and Canadian waters.

2. Description of the Individual Reviewer's Role in the Review Activities,

A peer review meeting was held at the Northwest Fisheries Science Center in Seattle, Washington, on January 21-24, 2014. The CIE review panel consisted of Drs. Gary Melvin (Panel Chair; Canada), François Gerlotto (France), George Rose (Canada) and Jon Helge Vølstad (Norway). Presentations were made to the CIE review panel by SWFSC and NWFSC staff, during which the CIE panel members asked questions.

Preparations in advance of the peer review meeting included a review of background material and reports provided by the NMFS Project Contact Stacey Miller (Appendix A) via email with a link to Google Drive on January 9, 2014.

A series of very informative power-point presentations were given during the review meeting:

A. Species Biology and Surveys
- Biology of Pacific sardine (Russ Vetter)
- Biology of Pacific hake (Michelle McClure)
- Brief history of the collaborative SWFSC-NWFSC surveys (Michelle McClure)
- Focus of this review (Russ Vetter)

B: Historical Individual Surveys
- History of acoustic-trawl surveys of Pacific sardine (David Demer)
- History of acoustic-trawl surveys of Pacific hake (Larry Hufnagle)

C. Joint SaKe Survey (Strengths and Challenges of Current Solution)
- Development of Collaborative Sardine and Hake Surveys (SaKe): Personnel, Equipment, Ships, Transects, and Acoustic, Biological, and Ecological Sampling (David Demer and Larry Hufnagle)
- Strengths and Challenges of Jointly Conducting the Survey -- Sardine (David Demer)
- Strengths and Challenges of Jointly Conducting the Survey -- Hake (Larry Hufnagle)

D. Evaluation of Trade Offs (Strengths and Challenges of Proposed Future Solutions)
- Proposals for Annual or Biennial, Single- or Multi-Species Surveys with or without Ecological Sampling (Russ Vetter and Michelle McClure)

During the morning meeting of January 23, Russ Vetter (SWFSC) and Michelle McClure (NWFSC) presented several options schematically for how future joint or independent sardine and hake surveys could be conducted. The CIE panel met in a closed session at the NWFSC in the afternoon of January 23. In the morning of January 24 the CIE panel met with SWFSC and NWFSC directors and senior staff to identify any unanswered questions.

3. Summary of Findings for each ToR

1) Review background materials and documents that detail acoustic-trawl survey design and methods, and data analysis methods and results for:
    a. Pacific sardine surveys;
    b. Pacific hake survey;
    c. Joint sardine and hake (SaKe) surveys.

The bibliography list (Appendix I) and the Statement of Work (Appendix II) describe the documents reviewed and review activities, respectively, as part of a independent peer review completed for the Center for Independent Experts (CIE). The material provided suggests that the

summer is favorable for acoustic surveys since the CPS are spatially separated at this time. In a prior CIE review in 2011 it was concluded that there are no major problems with acoustic technique and methodology and it was the best that could be used at this time. Therefore I will assume that the acoustic method has been evaluated and accepted. The independent sardine and hake surveys and the joint (SaKe) survey have been used to inform the assessment for both species without major issues. Some concerns were raised about reduced collection of oceanographic and environmental data during the SaKe surveys.

2) Evaluate the historic, independent sardine and hake survey designs, methods, and analytical approaches including data preparations and statistical (e.g. geostatistical) analyses to estimate target species abundances, distributions, and biomasses, and associated uncertainties.

The independent bi-annual sardine and hake surveys have employed sound survey designs and analytical methods for estimating abundance and biomass, and have mostly provided adequate spatial coverage of the stocks. The statistical aspects of the surveys are further discussed in section (3) below.

The development of acoustic-trawl survey methods for abundance estimation of sardine and other costal pelagic species (CPS) were started by SWFSC in the early 1970s, and the current survey coast-wide bi-annual surveys conducted from the Mexico border to Canada started during spring of 2006. In 2008, spring and summer surveys were conducted, while spring surveys were conducted in 2010 and 2011.

During summer, the sardine and other CPS are patchier, and better separated spatially than during spring, which is advantageous for the combined acoustic-trawl estimates of abundance. However, sardine, and anchovy in particular are found in more shallow waters, closer to shore during summer, which can introduce bias since portion of the fish may be in the acoustic blind zone close to the surface. Also, fish avoidance may be more of a problem during summer. SWFSC argued that the biases did not have significant effects on biomass estimates, since the biomass estimates during the spring and summer in the same did not differ significantly. This argument is not entirely convincing since the biomass estimates had moderate to low precision (relative standard errors of around 30%), and therefore the power to detect differences were low. The potential sources of bias due to portion of the northern stock being in Mexican waters, or variable and unknown portions of the southern stock being in US waters has also been considered based on the comparison of biomass estimates from spring and summer surveys. Again, the moderate to low precision in the biomass estimates suggests that bias cannot be excluded.

The hake survey started in 1977, and was conducted tri-annually by AFSC in the US till 1992, when the joint hake survey with Canada started. The triennial surveys from 1977–1992 are not used in the assessment because the survey covered a reduced depth range mainly in U.S. waters. This strict position is nevertheless difficult to understand given the large proportion of the biomass observed in US waters (~ 95%). Since 1995, the survey design and acoustic methods in the US-Canadian bi-annual joint survey for hake have been consistent, with a S-N coverage from

near Morro Bay to Dixon Entrance, AK, which covers hake of age 2+. AFSC conducted the US survey of hake till 2001, and since 2003 the US component of the survey has been conducted by NWFSC.

The independent sardine and hake acoustic trawl surveys are well designed, with systematic spacing of transects combined with biological sampling along transects using trawls. The trawl sampling for hake is performed during the day, while for sardine the biological sampling is conducted at night to take advantage of sardine being dispersed and also a lower escapement of fish due to reactions to the gear. The sampling for sardine is conducted along the acoustic transect taken the day before, thus using extra ship time to go back. The duration of both surveys is long (between 60 and 100 days), which is not ideal for migrating fish populations, although it was argues that migration speed of fish is low and that bias issues are minor. The survey for hake is conducted in collaboration with Canada to cover the distribution of the stock. The sardine survey, which is conducted by the US only, is extended into Canadian waters in years when the sardine stock extends into Canada.

For the sardine survey, the estimation of the variance in the target species abundance estimates were based on bootstrapping, under the assumption that the transects were randomly selected within strata (this is further discussed below). This suggests that the precision estimates are biased upwards (see discussion below). For the hake survey a model-based approach (kriging) is used to estimate abundance % biomass and the associated precision. The kriging estimate of precision is based on an isotropic (direction-invariant) variogram. The variance estimation for both surveys is discussed further in the next session.

The systematic design for the separate acoustic-trawl surveys has proven to provide highly precise annual estimates of abundance and biomass for assessment of hake, and moderately precise estimates for sardine. The acoustic methodology for these two series of surveys have been separately reviewed by CIE experts and found to be technically and statistically sound.

3) Evaluate the current joint SaKe survey design, methods, and analytical approaches including data preparations and statistical (e.g. geostatistical) analyses to estimate target species abundances, distributions, and biomasses, and associated uncertainties.

In response to a very low estimate of hake abundance for 2011, an additional hake survey was conducted during summer of 2012 by NWFSC in conjunction with the SWFSC sardine survey in US waters, and Canada also conducted the hake survey in their waters. This joint sardine and hake survey (SaKe) was also conducted in 2013 using the vessel R/V Bell M. Shimada in US waters, and transects were extended to 35 nm offshore (or 1500 m water depth, whichever greater) to cover sardine habitat. The Fishing Industry helped conducting biological sampling using FV Forum Star. NOAA Ship Bell M. Shimada was used to survey up to North end Vancouver Island (Canada), while the vessel W.E. Ricker conducted standard survey operation in Canada. The collaboration with the industry was very advantageous as this allowed extra trawling for hake during day while Shimada continued acoustic survey and trawl sampling for sardine at night.

The systematic design for the SaKe acoustic-trawl survey has proven to provide highly precise annual estimates of abundance and biomass for assessment of hake, and moderately precise estimates for sardine. The systematic design with equal spacing of transects is a robust for multiple coastal pelagic species with varying areas of occupancy, provided that the spatial coverage E-W and N-S is adequate. Many studies have concluded that a systematic design with regularly spaced samples can be optimal for a variety of reasonable spatial correlation functions of the sampled populations (see Steven and Olsen 2004, and many references therein). The acoustic-trawl survey with 10 nm spacing of transects provides estimates of abundance and biomass for hake with relative standard error (RSE = SE/Mean) in 2012 and 2013 around 5%, while biomass estimates for sardine based on the 2012 and 2013 SaKe surveys had moderate to low precision with RSE of approximately 33% and 28%, respectively. More precise estimate of sardine biomass could be achieved by allocating more sampling effort to cover sardine habitat, with little loss in the precision in biomass estimates for hake. Also, for example, if anchovy becomes the dominant cps species during a period or most important to the coastal fishery – then more effort could be allocated to better characterize habitat for anchovy and perhaps increase sampling density. When the spatial pattern or locations of high-density patches of hake or CPS can be predicted in advance, for example by using more current data from the fishing fleet or predictions from environmental data, then improved stratification and optimization of sampling effort across strata can bring down the variability in density and biomass estimates without increasing the cruise-time (see, e.g., Everson 1996; Jolly and Hampton1990).

The spacing (10 nm) between acoustic transects in the SaKe surveys is so dense that biomass estimates for neighboring primary sampling units (transects) are correlated for hake. This suggests little loss in precision in biomass estimates for hake if the spacing between transects is reduced to, say, 15 nm, in the baseline SaKe survey. The effects of sample size (number of transects) on the relative error of biomass estimates can be evaluated through simulations based on historic data. Some increase in spacing of the baseline transects along the coast would allow an increase in sample sizes for CPS with more limited area of occupancy. Also, the accuracy of hake and sardine biomass estimates may be improved if the length of transects E-W are extended when needed to improve coverage. A simulation study presented during the review has already shown that the random removing of 10 transects had negligible (0.2% reduction) in the relative standard error of the hake biomass estimate.

The current kriging method employed to estimate the precision in abundance and biomass estimates for hake is based on the assumption of an isotropic (direction-invariant) variograms. This is a fairly strong assumption since for lags less than 10 nm between observations (the spacing between transects) the spatial autocorrelation in hake density is primarily derived from data along transects in the E-W direction. The systematic spacing of transects employed in the SaKe survey maximizes the distance between transects in each stratum, and therefore little information is available to model the spatial correlation at shorter lags than the spacing between regular transects. Future surveys could include additional transects that are optimized towards the estimation of variograms for use in kriging (Mueller and Zimmermann 1999). A number of transects could be randomly allocated so that over time information on the spatial autocorrelation between transects is obtained for lags less than 10 nm. According to the NEFWS presentations and discussions at the review meeting, the spacing of transects at 10 nm lags is based on trying to achieve correlation between transects. This justification is hard to understand since the effective

sample size for a given number of transects is reduced when neighboring transects are correlated. Systematic spacing that minimizes correlation gives the largest effective sample size for a given number of transects.

The acoustic-trawl survey for hake can also be analyzed as a stratified cluster sampling design, with primary sampling units (transects) of unequal size (e.g., Cochran 1977; Lehtonen & Pahkinen 2004; Wolter 1985). A simple approach would be to follow Jolly & Hampton (1990) and assume that the primary sampling units (transects) were selected randomly from all possible transects within each stratum. A separate ratio estimator for a two-stage survey (Cochran 1977; Jolly & Hampton 1990) can then be applied to estimate the overall mean density of hake across strata, and the variance can be estimated trough bootstrapping of PSUs.

According to my interpretation, the estimation of sardine abundance and biomass is based on similar methods as Jolly & Hampton (1990), with the assumption of random samples of transects within strata, but it appears that the varying transect lengths is ignored in the estimation. It was mentioned that the variance estimates were based on bootstrap re-sampling of sardine density estimates for the transects. If so, this may introduce bias if the transects in a strata varies in length.

I recommend that analysis be conducted to assess the expected precision (RSE) in estimates of hake abundance and sardine abundance as a function of sample sizes (number of transects). The expected RSE for varying sample sizes can then be accessed through bootstrapping. Dunn and Harrison (1993) show that a post-stratification of the systematic sample (e.g., pooling of 2 neighboring transects to yield post strata with two samples each), and the use of a variance estimator that treats the systematic sample of transects as a stratified random sample, may provide more accurate variance estimates than the common method of treating the survey as a stratified random, based on original strata boundaries. They argue that although both methods of estimating sampling error for a systematic survey are likely to provide an over-estimate of the true sampling error, the post hoc stratification is the better of the two.

For the hake component of the survey, it is also recommended that the subsampling for age (number of otoliths sub-sampled from each trawl catch) be evaluated. The effective sample size for estimating age is generally driven by the number of transects and trawl stations sampled, and may be little affected if less fish are aged at each station. Based on experience from many large scale surveys in Norway, I believe that the collection of 50 otoliths per trawl station could likely be reduced in half with negligible loss in the precision of abundance-at-age estimates. Using historic data, it would be an easy exercise to resample age-readings and then estimate the precision in estimates of hake abundance by age-class for different sub-sample sizes (say, 10, 20, 30, 40, and 50).

I also recommend that the hake data from overlapping transects between US-Canadian ships conducted in the past be analyzed to assess ship differences. In the last couple years with the joint survey, the process has not been continued due to limited resources/lack of time. Everything is reviewed jointly after the survey. To make sure everyone is interpreting things the same way.

4) Evaluate the tradeoffs, in terms of costs, benefits, and consequences, of transitioning from independent surveys to a joint sardine-hake survey, particularly regarding its potential to provide population trend information to each of the assessments.

Survey design to support an ecosystem approach needs to cover the complex of CPS and not only sardine and hake. A baseline acoustic-trawl survey with equally spaced acoustic transects will continue to support the hake and sardine assessments which for now is most important, but will also provide reasonable estimates for other CPS. Increasing demands related to ecosystem-based management suggest that the continuation of two independent large scale surveys focused on single species (sardine and hake) cannot be defended in the long run. A joint sardine-hake survey (SaKe) will allow concurrent sampling of multiple CPS while continuing to support stock assessment for hake. In particular, a SaKe with the use of two US vessels that are sister ships would allow acoustic estimates for multiple species. The two NOAA ships are very similar (new Laskar is a sistership of Shamada), which suggest less concern about ship-effects, and the possibility to reduce survey time and thus secure a more synoptic coverage of migrating species. The summer period is favorable for an acoustic-trawl survey because summer weather is much better for sampling than in spring, where bad weather conditions can impede sampling. One concern is that sardine is distributed in more shallow waters during summer, which could results in boat avoidance. It was argued that this is not a big concern because in three years of comparing spring and summer surveys, there is no statistical difference in sardine biomass estimates, and that the summer estimates likely are not biased. The moderate to poor precision in sardine biomass estimates, however, also can explain why there are no differences. The continued development and use of new technology (e.g., stationary acoustic platforms, optic sampling methods, and multi-beam sonars) is important to evaluate such concerns for multispecies CPS surveys.

5) Evaluate the potential of the SaKe survey design and analysis, or an alternative, to evaluate the status and trends of hake, as managed by the International Hake Treaty, the southern stock of sardine, and other stocks in the Pacific Fisheries Management Council's Coastal Pelagic Fisheries Management Plan (CPS-FMP) including: northern anchovy (northern and central stocks), Pacific mackerel, jack mackerel, market squid, and krill.

The SaKe surveys conducted in 2012 and 2013 suggest that a continued joint bi-annual SaKe survey with US and Canada will provide sufficient information to evaluate status and trends in biomass and abundance of the sardine and hake stocks in US and Canadian waters. For the southern stock of sardine, and for 1-year old hake, there are strong indications of bias since an unknown portion of the stock is in Mexican waters. It would clearly be very beneficial if the survey could be extended into Mexico. The potential for the joint survey to provide reliable abundance and biomass estimates for northern anchovy (northern and central stocks), Pacific mackerel, jack mackerel, market squid, and krill is difficult to evaluate given the information provided and presented to the Panel. However, the limited information presented on the life histories and distribution of Northern anchovies, Pacific mackerel, Jack mackerel, market squid and krill suggest that the SaKe can be expanded from one or two CPS species to a pelagic multi-species survey.

The optimal survey design of the SaKe will depend on the primary objective(s). Since the agency has a mandate to move toward an ecosystem approach, the combination of a baseline systematic survey design with even spacing of transects and some additional sampling effort focused on selected CPS could be a good option. If the baseline spacing of transects is sufficient to support the hake assessment (relative standard error of 10% in biomass estimates should suffice) then additional sampling effort could be directed to other important species such as sardine, or anchovy when needed.

6) Evaluate the tradeoffs, in terms of costs, benefits, and consequences, of:
    a. separate hake and sardine surveys every year or every other year, with or without ecosystem sampling
    b. joint sardine and hake surveys every year or every other year, with or without ecosystem sampling,
    c. alternative joint survey options for hake or sardine every year or every other year, with or without ecosystem sampling, particularly regarding their potentials to: i) estimate population parameters for hake, sardine, and other forage species; ii) put that information into the context of their biotic and abiotic environments; and iii) characterize their roles in the California Current Ecosystem. Provide specific recommendations for short- and long-term improvements to anticipate compromises associated with sardine-hake-ecosystem surveys.

A joint sardine and hake survey (SaKe) has the added benefit of allowing concurrent sampling of multiple CPS and hake, as well as the collection of environmental and oceanographic data proceed that logistical and staffing limitations be worked out. A joint SaKe is a far better platform than separate hake and sardine surveys for supporting ecosystem based management. As discussed in other sections of this report, it is recommended that the SaKe be conducted bi-annually over a 5-year period. In particular it is important to solve logistical and staffing concerns so that environmental and oceanographic data collections can be part of the routine survey. Such data will be an essential part of ecosystem sampling. The possible move to annual surveys can be evaluated when the agencies has more experience with conducting joint surveys. The joint SaKe will allow the collaboration and cooperation of the NWFSC and SWFSC scientists, which will benefit both groups in terms of the development of effective survey sampling methods in support of stock assessments and ecosystem modeling. Combining the knowledge of advanced technology with survey sampling expertise will lead to improvements and efficiencies in the survey.

7) Evaluate proposals and provide recommendations to increase the efficacies and efficiencies (e.g., through advanced technologies) of sardine, hake, sardine-hake and sardine-hake-ecosystem surveys, based on SaKe 2012 and 2013 survey experiences.

The continuation of a joint SaKe survey provides an excellent platform for the development and implementation of new sampling technology for obtaining representative information on the biological characteristics (species and size composition) of fish and plankton in the pelagic and semi-pelagic community. The very strong expertise in acoustic and optical methods at SWFSC,

in combination with the trawl sampling and gear expertise at NWFSC and AFSC, can allow the development of more efficient sampling methods for ecosystem monitoring. It is recommended that methods development, testing, and implementation be conducted through experiments embedded in the SaKe surveys, in conjunction with research experiments in "off years". New sampling methods such as the use of open trawls and high sensitivity color stereo cameras (such as Deep Vision) may be used for the improved vertical sampling of fish and plankton schools recorded acoustically. Stereo cameras mounted in an open trawl cab be used to provide accurate length measurement and for species ID. Also, the use of multi-beam sonars in addition to the standard acoustic methods may be used for bias correction, for example by providing data on schools near the surface. Advanced technology can help improve the estimates of target strength for krill and multiple CPS, and thus improve the accuracy of biomass estimates.

8) Reviewers shall provide a critique of the NMFS review process, including suggestions for improvements of both process and products.

The peer review process was very well organized, and the presentations and discussions at the peer review meeting were invaluable for understanding the complexity of the joint SaKe survey. The background material and discussion did not provide sufficient information to fully evaluate the tradeoffs, in terms of costs and benefits of the various options, and certainly not economic aspects. For a review with such a wide range of topics expertise in multiple disciplines is required, and my independent report clearly cannot cover all topics in detail. For technical aspects of the acoustic methodology I have deferred to fellow CIE team members who are specialists. The CIE review team with 4 members had a range of expertise that allowed each of us to focus more on the topics within our core expertise, and I felt that we jointly covered the ToR well.

Conclusions and Recommendations

I recommend that a Joint Pacific Sardine and Pacific Hake survey (SaKe) be conducted, instead of independent hake and sardine surveys. Ideally, the SaKe would be conducted annually since abundance of hake and the CPS typically exhibit large annual variability, but logistic, resource and personnel challenges must be overcome before an annual survey can be recommended. I therefore support option 1, with a bi-annual SaKe survey during summer, and the more flexible use of ship-time research in intermittent years over a 5-year period. This will allow NOAA to develop effective survey methods to support multiple objectives, and also to improve the logistics and cost-efficiency of a joint survey. A bi-annual SaKe in 5-year period will allow more focus on research to develop a long-term approach for an ecosystem survey that also provides sufficiently reliable data for single-stock assessments. Shared development of survey methods and the shared expertise within NOAA (i.e. SWFSC, NWFSC, and AFSC) will be particularly beneficial for the development of efficient future sampling tools (optical, acoustic, nets). Combining the knowledge of advanced technology at SWFSC with the survey sampling expertise in the NWFSC will lead to improvements and efficiencies in the survey.

During the 5-year "test period" for SaKe it is recommended that NOAA develop an effective system for handling the data flow for an ecosystem survey that covers plankton, multiple CPS and hake, and oceanographic and environmental data. In particular, the development of joint or linked database would help facilitate modeling and also improve QA/QC, as compared to the current situation where two groups dealing with sardine and hake surveys "go through the data" independently. Clearly, the use of acoustics for surveying multiple CPS and krill, as well as hake, suggest that a system be put in place for joint scrutinizing of the echograms along the cruise-track.

The ecosystem measurements in joint SaKe could largely mirror the data collections in CalCOFI, and the concurrent sampling would help ensure standardization of methods. The linking of databases could work as a "single database" where everyone extracts information for statistical analysis and modeling. This would aid NOAA's move toward a cooperative management approach. It is recommended that SWFSC and NWFSC plan joint workshops during the 5-year development phase to facilitate effective collaboration and shared expertise.

From an acoustic perspective the survey design and transect spacing used in the 2013 SaKe provide adequate, possibly more than adequate, coverage to estimate the biomass of hake and moderate precision for sardine. It is recommended that simulations be conducted to quantify the expected precision in hake and sardine biomass estimates as a function of the number of transects sampled. This can be done through bootstrapping. Also, it is recommended to evaluate the precision in estimates of abundance-at-age for hake for varying sub-sample sizes. It is likely that the current sample size of 50 otoliths could be substantially reduced with minimal loss in precision of the estimated age-composition of hake.

Although not a focus of this review, it concerns me that sources of uncertainty on the stock assessment of hake due to sampling errors in estimated catch-at-age for the commercial fisheries (removals) appeared to be ignored. Tables reviewed in the material provided for this review only listed the number total number of age readings. This is not very informative, as the precision in estimates of catch-at-age is driven by the number of vessels and trips sampled, more so than the number of age readings (ICES 2013).

The systematic transect design for the acoustic survey, with some adjustments to the E-W spatial coverage, is likely to work well for Northern anchovies, Pacific mackerel, Jack mackerel, market squid and krill, but more research is needed to develop methods for representative biological sampling for species and size composition and target strength. The data from SaKe could be used not only to inform stock assessments but also broad scale ecosystems models that investigate impacts of environmental and climate change.

References

Cochran WG. 1977. Sampling Techniques. 3rd Edition. New York: John Wiley and Sons. 428 pp.
Efron B. 1982. The Jackknife, the Bootstrap and Other Resampling Plans. Society of Industrial and Applied mathematics (SIAM). CBMS-NSF Regional Conference Series in Applied Mathematics 92 pp.

Dunn, R. and A.R. Harrison. 1993. Two-dimensional Systematic Sampling of Land Use. Appl. Statist. 42 (4): 585-601.

Everson, I. M Bravington', C Gossa. 1996. A combined acoustic and trawl survey for efficiently estimating fish abundance. Fisheries Research 26:75-91.

ICES. 2013. Report of the second Workshop on Practical Implementation of Statistical Sound Catch Sampling Programmes, 6 - 9 November 2012, ICES Copenhagen. ICES CM 2012 / ACOM: 54 71 pp.

Jolly GM, Hampton I. 1990. A stratified random transect design for acoustic surveys of fish stocks. Canadian journal of fisheries and aquatic sciences 47: 1282-1291.

Lehtonen R, Pahkinen E. 2004. Practical Methods for Design and Analysis of Complex Surveys, 2nd edn. New York: John Wiley and Sons, 349 pages.

Mueller, W.G., and D.L. Zimmermann. 1999. Optimal designs for variogram estimation. Environmetrics, 10: 23-37.

Williams RL. 2000. A note on robust variance estimation for cluster-correlated data. Biometrics, 56: 645–646.

Wolter KM. 1985. Introduction to Variance Estimation. New York: Springer. 427 pp.

Appendix 1: Bibliography of materials provided for review

List of Background Materials provided to the Center for Independent Experts Panel Review of the Joint Pacific Sardine and Pacific hake (SaKe) acoustic-trawl survey vi Google Drive

Agenda Item A. Introduction and Background: Species Biology and Surveys

K. T. Hill, P. R. Crone, N. C. H. Lo, D. A. Demer, J. P. Zwolinski, and B. J. Macewicz. 2012. Assessment of the Pacific sardine resource in 2012 for U.S. Management in 2013. NOAA Technical Memorandum NMFS. NOAA-TM-NMFS-SWFSC-501

K. T. Hill. 2013. Pacific sardine biomass projection in 2013 for U.S. management during the first half of 2014 (Executive Summary).

J.P. Zwolinski and D.A. Demer, "A cold oceanographic regime with high exploitation rates in the Northeast Pacific forecasts a collapse of the sardine stock," Proceedings of the National Academy of Sciences 109(11): 4175-4180 (2012).

J.P. Zwolinski and D.A. Demer, "Environmental and parental control of Pacific sardine (Sardinops sagax) recruitment," ICES Journal of Marine Science, doi:10.1093/icesjms/fst173 (2013).

J.P. Zwolinski, R.L. Emmett, and D.A. Demer, "Predicting habitat to optimize sampling of Pacific sardine (Sardinops sagax)," ICES Journal of Marine Science, 68: 867–879. (2011).

D.A. Demer and J.P. Zwolinski, "Corroboration and refinement of a method to differentiate landings from two stocks of Pacific sardine (Sardinops sagax) in the California Current," ICES Journal of Marine Science, doi.10.1093/icesjms/fst135 (2013).

Hicks, A.C., Taylor, N., Grandin, C., Taylor, I.G., and Cox, S. 2013. Status of the Pacific hake (whiting) stock in U.S. and Canadian waters in 2013. (2013 stock assessment for Pacific hake).

Ressler, P.H., Holmes, J.A., Fleischer, G.W., Thomas, R.E. and K.C. Cooke. 2007. Pacific hake, Meluccius productus, Autecology: a timely review. Mar. Fish. Review, 69:1-24.

Bailey, K. 1981. Larval transport and recruitment of Pacific hake. Mar. Ecol. Prog. Ser. 6: 1-9.

Saunders, M. W. and G.A. McFarlane. 1997. Observations on the spawning distribution and biology of offshore Pacific hake (Merluccius productus). CalCOFl Rep., Vol. 38: 147-157.

Dorn, M. W. 1995. The effects of age composition and oceanographic conditions on the annual migration of Pacific whiting, Merluccius productus. ColCOFl Rep., Vol. 36: 97-105.

Agostini, V. N., Francis, R. C., Hollowed, A., Pierce, S.D., Wilson, C.D., and A.N. Hendrix. 2006. The relationship between Pacific hake (Merluccius productus) distribution and poleward subsurface flow in the California Current system. Can. J. Fish. Aquat. Sci. 63: 2648–2659.

Cook, K.D., Holmes, J., Fleischer, G.W., Thomas, R.E., and P.A, Ressler. 2006. Distributional changes observed in the geographic range of Pacific Hake (Merluccius productus) in association with ocean conditions off the Pacific coast of Canada and the United States. In: Proceedings from the 2006 ICES Annual Science Conference, Theme Session on: Large-scale changes in the migration of small pelagic fish and the factors modulating such changes. Available from: PISCES, Institute of Ocean Sciences, P.O. Box 6000, Sidney, British Columbia. Canada V8L 4B2.

Phillips, J.A., Ralston, S., Brodeur, R.D., Auth, T.D., Emmett, R.L., Johnson, C., and V.G.

Wespestad. 2007. Recent pre-recruit Pacific hake (Merluccius productus) occurrences in the Northern California Current suggest a northward expansion of their spawning area. CalCOFI Rep., Vol. 48: 215-229.

Agenda Item B: Historical Individual Surveys

Protocols for the historic Pacific sardine survey are detailed in references B2. and B3.
D.A. Demer, J.P. Zwolinski, K.A. Byers, G.R. Cutter, J.S. Renfree, T.S. Sessions, B.J. Macewicz, "Prediction and confirmation of seasonal migration of Pacific sardine (Sardinops sagax) in the California Current Ecosystem," Fisheries Bulletin, 110:52-70 (2012).

J.P. Zwolinski, D.A. Demer, K.A. Byers, G.R. Cutter, J.S. Renfree, T.S. Sessions, and B.J. Macewicz, "Distributions and abundances of Pacific sardine (Sardinops sagax) and other pelagic fishes in the California Current Ecosystem during spring 2006, 2008, and 2010, estimated from acoustic—trawl surveys," Fishery Bulletin 110: 110-122 (2012).

J.P. Zwolinski and D.A. Demer, "Measurements of natural mortality for Pacific sardine (Sardinops sagax)," – ICES Journal of Marine Science, doi:10.1093/icesjms/fst110. (2013).

D.A. Demer, J.P. Zwolinski, G.R. Cutter, Jr, K.A. Byers, B.J. Macewicz, and K.T. Hill, "Sampling selectivity in acoustic-trawl surveys of Pacific sardine (Sardinops sagax) biomass and length distribution," ICES Journal of Marine Science, doi:10.1093/icesjms/fst116 (2013).

Chu, D., Thomas, R.E., de Blois, S.K., and Hufnagle Jr., L.C. Unpubl. Manuscr. Pacific Hake Integrated Acoustic and Trawl Survey Methods, report date 2013. (Available from Northwest Fisheries Science Center, 2725 Montlake Blvd. E., Seattle, WA 98112. 2012. The 2011 Integrated Acoustic and Trawl Survey of Pacific Hake (Merluccius productus) in U.S. and Canadian Waters off the Pacific Coast. CRUISE REPORT, CRUISE NO: SH2011-03. NOAA Fisheries, Northwest Fisheries Science Center. 19 p.

Swartzman, G. 1997. Analysis of the summer distribution of fish schools in the Pacific Eastern Boundary Current. ICES Journal of Marine Science, 54: 105–116.

Agenda Item C. Joint SaKe Survey (Strengths and Challenges of Current Solution):

Joint SaKe Survey Protocols / Cruise Instructions NMFS, NWFSC. 2013. The 2012 Joint U.S.-Canada Integrated Acoustic and Trawl Survey of Pacific Hake (Merluccius productus) and Pacific Sardine (Sardinops sagax). CRUISE REPORT, CRUISE NO: SH2012-04 NOAA Fisheries, Northwest Fisheries Science Center. 23 p.

Agenda Item D. Evaluation of Trade Offs (Strengths and Challenges of Proposed Future Solutions)

PowerPoint presentations provided during review.

E. Additional References

D.A. Demer and J.P. Zwolinski, "Reply to MacCall et al.: Acoustic trawl survey results provide unique insight to sardine stock decline," Proceedings of the National Academy of Sciences, doi:10.1073/pnas.1203758109, 109(19): E1132-E1133 (2012).

Hollowed, A.B. and K.M. Bailey. 2009. Climate and Fisheries: The Past, The Future, and The Need for Coalescence. In: R.J. Beamish and B.J. Rothschild (eds.), The Future of Fisheries Science in North America, 597. Fish & Fisheries Series, Springer Science + Business Media B.V.

Hollowed, A.B. , Hare S.R. and W.S. Wooster. 2001. Pacific Basin climate variability and patterns of Northeast Pacific marine fish production. Progress in Oceanography 49: 257–282.

D.A. Demer, G.R. Cutter, J.S. Renfree, and J.L. Butler. "A statistical-spectral method for echo classification". ICES Journal of Marine Science, 66: 1081–1090 (2009).

Bakun, A. 1990. Global climate change and intensification of coastal ocean upwelling. Science. Vol. 247:198-201 (Electronic copy not currently included).

Appendix 2: A copy of the CIE Statement of Work

Attachment A: Statement of Work for Dr. Jon Helge Vølstad

External Independent Peer Review by the Center for Independent Experts

Review of Pacific sardine and Pacific hake joint acoustic-trawl survey

Scope of Work and CIE Process: The National Marine Fisheries Service's (NMFS) Office of Science and Technology coordinates and manages a contract providing external expertise through the Center for Independent Experts (CIE) to conduct independent peer reviews of NMFS scientific projects. The Statement of Work (SoW) described herein was established by the NMFS Project Contact and Contracting Officer's Technical Representative (COR), and reviewed by CIE for compliance with their policy for providing independent expertise that can provide impartial and independent peer review without conflicts of interest. CIE reviewers are selected by the CIE Steering Committee and CIE Coordination Team to conduct the independent peer review of NMFS science in compliance the predetermined Terms of Reference (ToRs) of the peer review. Each CIE reviewer is contracted to deliver an independent peer review report to be approved by the CIE Steering Committee and the report is to be formatted with content requirements as specified in **Annex 1**. This SoW describes the work tasks and deliverables of the CIE reviewer for conducting an independent peer review of the following NMFS project. Further information on the CIE process can be obtained from www.ciereviews.org.

Project Description: The CIE reviewers will serve on a methodology review panel to perform an independent peer review of the Pacific sardine and Pacific hake joint acoustic-trawl survey conducted by the NMFS's Southwest Fisheries Science Center (SWFSC) and Northwest Fisheries Science Center (NWFSC). In 2012, a newly integrated acoustic-trawl survey of both Pacific Hake and Pacific sardine was implemented in waters off the US and Canada. This effort was the result of a unique collaboration and partnership between SWFSC and NWFSC fishery scientists, as well as Canada's Department of Fisheries and Oceans (DFO) and the fishing industry. The survey's primary goal was to measure the distributions and abundances of Pacific hake and Pacific sardine. In addition, oceanographic and environmental data were sampled to estimate the physical oceanographic habitats for each target species. Results of this survey were used in the 2013 assessment of the Pacific hake stock in US and Canadian waters. A review of the joint acoustic-trawl survey of Pacific hake and Pacific sardine will be conducted to review the survey methodology and analytical approaches to estimate abundance, distribution and biomass of Pacific hake and Pacific sardine resources.

Requirements for CIE Reviewer:
Four CIE experts, three independent reviewers and one panel Chair, shall participate in a panel peer review in accordance with the SoW and ToRs herein. The three CIE reviewers shall have the combined expertise and working knowledge in acoustic-trawl survey design, operation, sampling and analysis; ecosystem survey design, operation, sampling and analysis; spatial sampling and analysis with experience in geo-statistics; and familiarity with groundfish and/or

coastal pelagic species with annual migration. At least one reviewer shall have working knowledge and expertise in the application of acoustic fish surveys in stock assessments. Experience (and/or familiarity) with acoustic sampling for mid-water, bottom and pelagic species is desirable. In addition to the three CIE reviewers, one CIE expert will serve as Panel Chair. The Panel Chair shall have excellent facilitation and communication skills and expertise in acoustic-trawl surveys and/or one of the areas of expertise outlined above. The primary role of the Panel Chair will be to facilitate an impartial review panel and provide a summary report of the panel proceedings. The Panel Chair may also actively participate in panel discussion and provide feedback during the panel meeting. The CIE reviewer's duties shall not exceed a maximum of 16 days to complete all work tasks of the peer review process. The Panel Chair's duties shall not exceed a maximum of 18 days to complete all work tasks of the facilitation and summary report process. The agenda for the Panel review meeting will be provided to reviewers along with background materials two weeks prior to the panel meeting.

Location/Date of Peer Review: Four CIE experts, one of which will serve as the Panel Chair, shall participate during a panel review meeting in Seattle, Washington to be held January 21-24, 2014.

Statement of Tasks: Each CIE expert shall complete the following tasks in accordance with the SoW, ToRs and Schedule of Milestones and Deliverables specified herein.

Prior to the Peer Review: Upon completion of the CIE expert selection by the CIE Steering committee, the CIE shall provide the CIE expert information (name, affiliation, and contact details) to the COR, who forwards this information to the NMFS Project Contact no later the date specified in the Schedule of Milestones and Deliverables. The CIE is responsible for providing the SoW and ToRs to each CIE expert. The NMFS Project Contact is responsible for providing the CIE experts with the background documents, reports, foreign national security clearance, and information concerning other pertinent meeting arrangements. The NMFS Project Contact is also responsible for providing the Chair a copy of the SoW in advance of the panel review meeting. Any changes to the SoW or ToRs must be made through the COR prior to the commencement of the peer review.

Foreign National Security Clearance: When CIE experts participate during a panel review meeting at a government facility, the NMFS Project Contact is responsible for obtaining the Foreign National Security Clearance approval for CIE experts who are non-US citizens. For this reason, the CIE experts shall provide requested information (e.g., first and last name, contact information, gender, birth date, passport number, country of passport, travel dates, country of citizenship, country of current residence, and home country) to the NMFS Project Contact for the purpose of their security clearance, and this information shall be submitted at least 30 days before the peer review in accordance with the NOAA Deemed Export Technology Control Program NAO 207-12 regulations available at the Deemed Exports NAO website: http://deemedexports.noaa.gov/compliance_access_control_procedures/noaa-foreign-national-registration-system.html

Pre-review Background Documents: Two weeks before the peer review, the NMFS Project Contact will send by electronic mail or make available at an FTP site to each CIE expert all

necessary background information and reports for the peer review. In the case where the documents need to be mailed, the NMFS Project Contact will consult with the CIE on where to send documents. Pre-review documents will be provided up to two weeks before the peer review. Any delays in submission of pre-review documents for the CIE peer review will result in delays with the CIE peer review process, including a SoW modification to the schedule of milestones and deliverables. Furthermore, the CIE experts are responsible only for the pre-review documents that are delivered to them in accordance to the SoW scheduled deadlines specified herein.

Panel Review Meeting: Each CIE reviewer shall conduct the independent peer review in accordance with the SoW and ToRs. **Modifications to the SoW and ToR cannot be made during the peer review, and any SoW or ToR modification prior to the peer review shall be approved by the COR and CIE Lead Coordinator.** Each CIE expert shall actively participate in a professional and respectful manner as a member of the meeting review panel, and their tasks shall be focused on the ToRs as specified in the contract SoW.

The NMFS Project Contact is responsible for any facility arrangements (e.g., conference room for panel review meetings or teleconference arrangements). The CIE Lead Coordinator can contact the Project Contact to confirm any peer review arrangements, including the meeting facility arrangements.

Contract Deliverables - Independent CIE Peer Review Reports: Each CIE reviewer shall complete an independent peer review report in accordance with the SoW. Each CIE reviewer shall complete the independent peer review according to required format and content as described in Annex 1. Each CIE reviewer shall complete the independent peer review addressing each ToR as described in Annex 2. The CIE expert serving as Panel Chair shall complete a summary report of the panel proceedings including a summary of the individual reviewers' major findings and recommendations. The summary report shall not be a consensus report.

Specific Tasks for CIE Reviewers: The following chronological list of tasks shall be completed by each CIE reviewer in a timely manner as specified in the **Schedule of Milestones and Deliverables**.

1) Conduct necessary pre-review preparations, including the review of background material and reports provided by the NMFS Project Contact in advance of the peer review;
2) Participate during the panel review meeting in Seattle, Washington during 21-24 January 2014, and conduct an independent peer review in accordance with the ToRs (Annex 2);
3) No later than February 7, 2014, each CIE reviewer shall submit an independent peer review report addressed to the "Center for Independent Experts," and sent to Mr. Manoj Shivlani, CIE Lead Coordinator, via email to shivlanim@bellsouth.net, and Dr. David Die., CIE Regional Coordinator, via email to ddie@rsmas.miami.edu. The CIE report shall be written using the format and content requirements specified in Annex 1, and address each ToR in Annex 2.
4) Work with the CIE Chair in providing comments and elaboration on any points raised in the CIE Chair's summary report that might require further clarification.

Specific Tasks for CIE Chair: The following chronological list of tasks shall be completed in a timely manner as specified in the **Schedule of Milestones and Deliverables**.

1) Conduct necessary pre-review preparations, including the review of background material and reports provided by the NMFS Project Contact in advance of the peer review;
2) Participate as the CIE Chair during the panel review meeting in Seattle, Washington during 21-24 January 2014, and facilitate the panel review maintaining the focus of the peer review in accordance with the ToRs (Annex 2);
3) Produce a Summary Report of the proceedings. The summary report shall not comprise a consensus report and will instead include a synoposis of each term of reference as per the chair's summary of each reviewer's determination. The CIE reviewers should have an opportunity to review and provide comments or elaboration on any points raised in the summary report that they feel might require further clarification. No later than February 21, 2014, the CIE Chair shall submit a Summary Report addressed to the "Center for Independent Experts," and sent to Mr. Manoj Shivlani, CIE Lead Coordinator, via email to shivlanim@bellsouth.net, and Dr. David Die., CIE Regional Coordinator, via email to ddie@rsmas.miami.edu. The Summary Report shall address each ToR in Annex 2.

Schedule of Milestones and Deliverables: CIE shall complete the tasks and deliverables described in this SoW in accordance with the following schedule.

17 December 2013	CIE sends the experts' contact information to the COR, who then sends this to the NMFS Project Contact
07 January 2014	NMFS Project Contact sends each CIE reviewer and the CIE Chair the pre-review documents
21-24 January, 2014	The CIE reviewers participate and conduct an independent peer review during the panel review meeting. The CIE Chair facilitates the impartial peer review and participates in panel discussion.
07 February 2014	Each CIE reviewer submits a draft CIE independent peer review report to the CIE Lead Coordinator and CIE Regional Coordinator. These reports will be forwarded to the CIE Chair by the CIE Lead Coordinator
14 February 2014	The CIE Chair submits the working Summary Report to the CIE reviewers
17 February 2014	The CIE reviewers provide their comments and elaborate on any points raised in the summary report that require additional explanation to the CIE Chair
21 February 2014	The CIE Chair submits the draft Summary Report to the CIE Lead Coordinator and CIE Regional Coordinator
28 February 2014	CIE submits the CIE independent peer review reports and CIE Chair's Summary Report to the COR
6 March 2014	The COR distributes the final CIE reports to the NMFS Project Contact and regional Center Directors

Modifications to the Statement of Work: Requests to modify this SoW must be made through the Contracting Officer's Technical Representative (COR) who submits the modification for approval to the Contracting Officer at least 15 working days prior to making any permanent substitutions. The Contracting Officer will notify the CIE within 10 working days after receipt of all required information of the decision on substitutions. The COR can approve changes to the milestone dates, list of pre-review documents, and Terms of Reference (ToR) of the SoW as long as the role and ability of the CIE experts to complete the SoW deliverable in accordance with the ToRs and deliverable schedule are not adversely impacted. The SoW and ToRs cannot be changed once the peer review has begun.

Acceptance of Deliverables: Upon review and acceptance of the CIE independent peer review reports and summary report by the CIE Lead Coordinator, Regional Coordinator, and Steering Committee, these reports shall be sent to the COR for final approval as contract deliverables based on compliance with the SoW. As specified in the Schedule of Milestones and Deliverables, the CIE shall send via e-mail the contract deliverables (the CIE independent peer review reports) to the COR (William Michaels, via William.Michaels@noaa.gov).

Applicable Performance Standards: The contract is successfully completed when the COR provides final approval of the contract deliverables. The acceptance of the contract deliverables shall be based on three performance standards: (1) the CIE reports shall have the format and content in accordance with Annex 1, (2) the CIE reports shall address each ToR as specified in Annex 2, (3) the CIE reports shall be delivered in a timely manner as specified in the schedule of milestones and deliverables.

Distribution of Approved Deliverables: Upon notification of acceptance by the COR, the CIE Lead Coordinator shall send via e-mail the final CIE reports in *.PDF format to the COR. The COR will distribute the approved CIE reports to the NMFS Project Contact and regional Center Director.

Support Personnel:

William Michaels, Program Manager, COR
NMFS Office of Science and Technology
1315 East West Hwy, SSMC3, F/ST4, Silver Spring, MD 20910
William.Michaels@noaa.gov Phone: 301-427-8155

Manoj Shivlani, CIE Lead Coordinator
Northern Taiga Ventures, Inc.
10600 SW 131st Court, Miami, FL 33186
shivlanim@bellsouth.net Phone: 305-383-4229

Roger W. Peretti, Executive Vice President
Northern Taiga Ventures, Inc. (NTVI)
22375 Broderick Drive, Suite 215, Sterling, VA 20166
RPerretti@ntvifederal.com Phone: 571-223-7717

Key Personnel:

Stacey Miller
NMFS Northwest Fisheries Science Center (NWFSC)
2032 SE OSU Drive, Newport OR 97365
Stacey.Miller@noaa.gov Phone: 541-961-8475

Michelle McClure
NMFS Northwest Fisheries Science Center (NWFSC)
2725 Montlake Blvd. E, Seattle WA 98112
Michelle.McClure@noaa.gov Phone: 206-860-3402

David Demer
NMFS Southwest Fisheries Science Center (SWFSC)
8901 La Jolla Shores Drive
La Jolla, CA 92037-1508
David.Demer@noaa.gov Phone: 858-546-5603

Annex 1: Format and Contents of CIE Independent Peer Review Report

1. Each CIE independent peer review report shall be prefaced with an Executive Summary providing a concise summary of the findings and recommendations.

2. The main body of each peer review report shall consist of a Background, Description of the Individual Reviewer's Role in the Review Activities, Summary of Findings for each ToR, and Conclusions and Recommendations in accordance with the ToRs.

   a. Reviewers should describe using their own words, the review activities completed during the panel review meeting, including a detailed summary of findings, conclusions, and recommendations.

   b. Reviewers should discuss their independent views on each ToR even if these were consistent with those of other panelists, and especially where there were divergent views.

   c. Reviewers shall provide a critique of the NMFS review process, including suggestions for improvements of both process and products.

   e. Each CIE independent peer review report shall be a stand-alone document for others to understand the proceedings and findings of the meeting, regardless of whether or not they read the summary report. Each CIE independent report shall be an independent peer review of each ToRs, and shall not simply repeat the contents of the summary report.

3. Each report shall include the appendices as follows:

   Appendix 1: Bibliography of materials provided for review
   Appendix 2: A copy of the CIE Statement of Work
   Appendix 3: Panel Membership and other pertinent information from the panel review meeting.

.

Annex 2: Terms of Reference (ToR) for the Center for Independent Experts Panel Review of the Joint Pacific Sardine and Pacific hake (SaKe) acoustic-trawl survey

The CIE Chair shall facilitate the panel review on the ToR, and each CIE reviewer shall conduct an independent peer review addressing each ToR;

9) Review background materials and documents that detail acoustic-trawl survey design and methods, and data analysis methods and results for:
    a. Pacific sardine surveys;
    b. Pacific hake survey;
    c. Joint sardine and hake (SaKe) surveys.

10) Evaluate the historic, independent sardine and hake survey designs, methods, and analytical approaches including data preparations and statistical (e.g. geostatistical) analyses to estimate target species abundances, distributions, and biomasses, and associated uncertainties.

11) Evaluate the current joint SaKe survey design, methods, and analytical approaches including data preparations and statistical (e.g. geostatistical) analyses to estimate target species abundances, distributions, and biomasses, and associated uncertainties.

12) Evaluate the tradeoffs, in terms of costs, benefits, and consequences, of transitioning from independent surveys to a joint sardine-hake survey, particularly regarding its potential to provide population trend information to each of the assessments.

13) Evaluate the potential of the SaKe survey design and analysis, or an alternative, to evaluate the status and trends of hake, as managed by the International Hake Treaty, the southern stock of sardine, and other stocks in the Pacific Fisheries Management Council's Coastal Pelagic Fisheries Management Plan (CPS-FMP) including: northern anchovy (northern and central stocks), Pacific mackerel, jack mackerel, market squid, and krill.

14) Evaluate the tradeoffs, in terms of costs, benefits, and consequences, of:
    a. separate hake and sardine surveys every year or every other year, with or without ecosystem sampling
    b. joint sardine and hake surveys every year or every other year, with or without ecosystem sampling,
    c. Alternative joint survey options for hake or sardine every year or every other year, with or without ecosystem sampling,

particularly regarding their potentials to: i) estimate population parameters for hake, sardine, and other forage species; ii) put that information into the context of their biotic and abiotic environments; and iii) characterize their roles in the California Current Ecosystem. Provide specific recommendations for short- and long-term improvements to anticipated compromises associated with sardine-hake-ecosystem surveys.

15) Evaluate proposals and provide recommendations to increase the efficacies and efficiencies (e.g., through advanced technologies) of sardine, hake, sardine-hake and sardine-hake-ecosystem surveys, based on Sake 2012 and 2013 survey experiences.

Agenda
The Center for Independent Experts Panel Review of the Joint Pacific Sardine and Pacific hake (SaKe) acoustic-trawl survey

NOAA Western Regional Center
7600 SandPoint Way NE, Building 1
Workforce Management Conference Room
Seattle, Washington 98115
January 21-24, 2014

Tuesday, January 21, 2014

8:30 a.m. Welcome, Purpose, and Introductions (Michelle McClure and Russ Vetter)

8:45 a.m. Review Meeting Agenda, Terms of Reference and Assignment of Rapporteur Responsibilities (Panel Chair)

Agenda Item A. Introduction and Background: Species Biology and Surveys

9:00 a.m. i. Biology of Pacific sardine (Russ Vetter)
ii. Biology of Pacific hake (Michelle McClure)
iii. Brief history of the collaborative SWFSC-NWFSC surveys (Michelle McClure)
iv. Focus of this review (Russ Vetter)

10:30 a.m. Coffee Break

Agenda Item B: Historical Individual Surveys

10:45 a.m. History of acoustic-trawl surveys of Pacific sardine (David Demer)

11: 30 a.m. Q & A

12:30 p.m. Lunch

1:30 p.m. History of acoustic-trawl surveys of Pacific hake (Larry Hufnagle)

2:30 p.m Q & A

3:30 p.m. Coffee Break

4:00 p.m. Public Comment

4:15 p.m. Panel Discussion

5:30 p.m. Panel Adjourns for the Day

Wednesday, January 22, 2014

8:30 a.m. Welcome and Schedule Overview

Topic C. Joint SaKe Survey (Strengths and Challenges of Current Solution)

8:45 a.m. Development of Collaborative Sardine and Hake Surveys (SaKe) : Personnel, Equipment, Ships, Transects, and Acoustic, Biological, and Ecological Sampling (David Demer and Larry Hufnagle)

9:45 a.m. Q & A

Wednesday, January 22, 2014 (Continued)

10:30 a.m.	Coffee Break
10:45 a.m.	Strengths and Challenges of Jointly Conducting the Survey -- Sardine (David Demer)
11:30 a.m.	Q & A
12:30 p.m.	Lunch
1:30 p.m.	Strengths and Challenges of Jointly Conducting the Survey -- Hake (Larry Hufnagle)
2:30 p.m.	Q & A
3:30 p.m.	Coffee Break
4:00 p.m.	Public Comment
4:15 p.m.	Panel Discussion / Report Drafting
5:30 p.m.	Panel Adjourns for the Day

Thursday, January 23, 2014

8:30 a.m.	Welcome, Schedule Overview, and Review of Primary Questions

Topic D. Evaluation of Trade Offs (Strengths and Challenges of Proposed Future Solutions)

8:45 a.m.	Proposals for Annual or Biennial, Single- or Multi-Species Surveys with or without Ecological Sampling (Russ Vetter and Michelle McClure)
9:45 a.m.	Q & A
10:30 a.m.	Coffee Break
12:30 p.m.	Lunch
1:30 p.m.	Panel Discussion
3:30 p.m.	Coffee Break
4:00 p.m.	Public Comment
4:15 p.m.	Panel Discussion / Report Drafting
5:30 p.m.	Panel Adjourns for the Day

Friday, January 24, 2014

8:30 a.m.	Welcome and Overview of the Day
8:45 a.m.	Report Drafting
12:30 p.m.	Lunch
1:30 p.m.	Report Out by Reviewers
2:00 p.m.	NWFSC and SWFSC Leadership Wrap Up with Panel (Closed Session)
3:00 p.m.	Panel Adjourns

Appendix 3: Panel Membership and other pertinent information from the panel review meeting.

CIE Review Panel
Dr. Gary Melvin, Center for Independent Experts (CIE), Panel Chair
Dr. François Gerlotto, Center for Independent Experts (CIE)
Dr. George Rose, Center for Independent Experts (CIE)
Dr. Jon Helge Vølstad, Center for Independent Experts (CIE)

.